

# Autotransplantation of premolars with closed root apices: an orthodontic case report

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**ABSTRACT** Autotransplantation of a premolar is a viable option in the orthodontic treatment of congenitally missing teeth. The ideal timing is when the root has developed to between two thirds and three fourths of the final root length. Autotransplantation of teeth with complete root development is less successful and is often regarded as an experimental procedure. This case report demonstrates successful orthodontic treatment of two such autotransplanted premolars.

**Key words:** Tooth; Tooth movement; Transplantation, autologous

## Introduction

Autotransplantation of teeth has been widely used in orthodontic treatment for cases with severe impaction, early loss of permanent teeth, or congenital aplasia. In the 1970s, Slagvold and Bjercke <sup>1-3</sup> studied transplanted premolars with partly formed roots. They showed that root development continued after transplantation, although the final root length was slightly shorter <sup>1-3</sup>. The transplants maintained their capacity for functional adaptation and endodontic treatment was usually not necessary. According to Zachrisson *et al* <sup>4</sup>, the three main indications for autotransplantation of developing premolars were unevenly distributed multiple agenesis, agenesis of the mandibular second premolars in low-angle face types with normal or weak facial profiles, and accidentally lost or congenitally missing maxillary incisors.

Various studies have identified factors that affect the success of autotransplantation, including pulp condition <sup>5-7</sup>, root development and root resorption <sup>5-9</sup>, eruption pattern <sup>10,11</sup>, and periodontal healing <sup>6,11-13</sup>. Autotransplantations of premolars with incomplete root formation

have high success rates <sup>8,9,14</sup>. The results of a long-term study on 370 autotransplanted premolars revealed that transplants with three fourths to full root development with wide open apices had the best prognosis after autotransplantation <sup>5,8,12</sup>. Transplantation at this stage of root development gives a good chance of pulp survival, limited risk of root resorption, and ensures sufficient final root length. Traumatic loss of permanent anterior teeth often occurs in children between 7 and 10 years of age, the years during which the premolar roots are developing, making autotransplantation of developing premolars a viable treatment option for traumatic tooth loss in younger patients.

Another important factor affecting successful autotransplantation is surgical technique. Damage to the periodontal ligament of the transplant might lead to ankylosis, resorption, and arrested root growth <sup>15</sup>. The recipient site should have an adequate bucco-lingual bone width, and should be prepared with a large round bur at low speed under vigorous irrigation with physiologic saline. The donor tooth should fit loosely in the recipient socket. It should be transplanted at a level in the alveolus corresponding to the original pre-transplant position. Transplants with complete root formation should be left out of occlusion, avoiding interferences (jiggling contacts) with the opposing teeth during the first 2 months. The tooth should be held in position for 1 to 2 weeks with flexible splinting to allow physiological mobility.

Few studies have reported on the effect of orthodontic movement on transplanted teeth. Lagerstrom and

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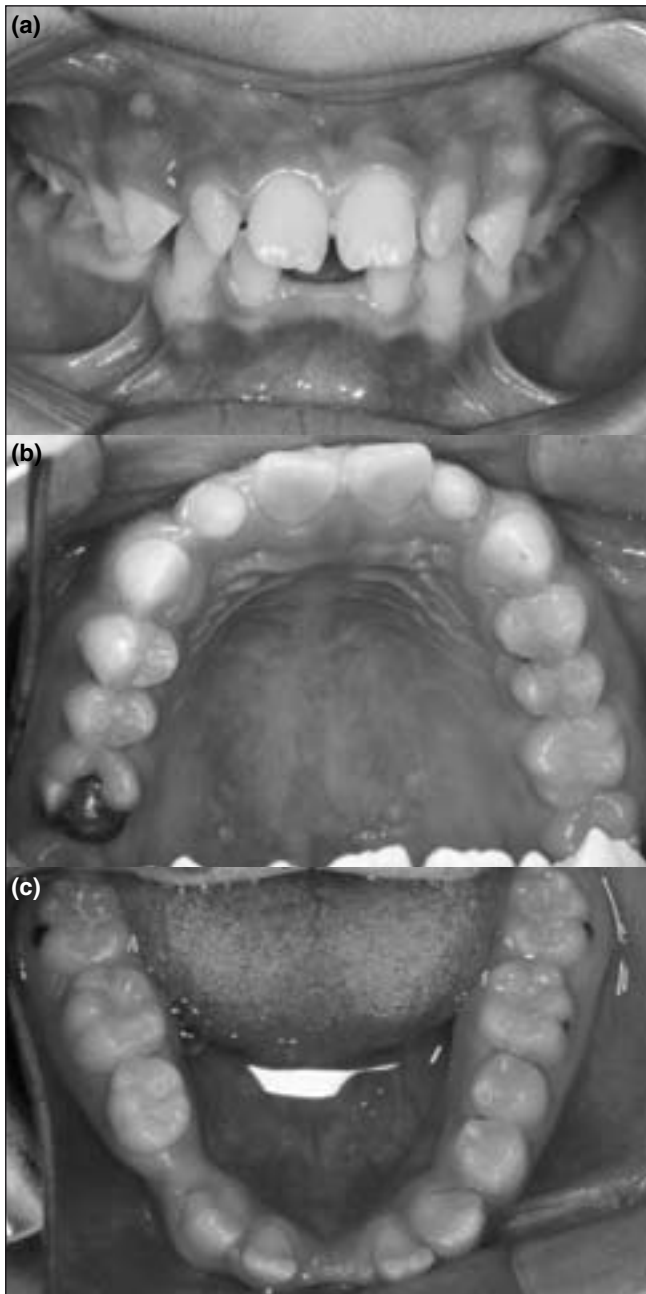
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**Figure 1** Pretreatment photographs

Kristerson<sup>16</sup> investigated the effect of orthodontic treatment on the root development of transplanted premolars. The authors found that transplanted premolars had shorter root lengths compared to the control teeth but orthodontic movement did not lead to further root shortening. Paulsen and Zachrisson<sup>7</sup> found that orthodontic rotation performed on autotransplanted premolars induced a significant shortening of tooth length (mean, 1.2 mm) and recommended active orthodontic forces be applied to the transplants within 3 to 9 months after autotransplantation<sup>7,17</sup>.

It has been shown that orthodontic movement initiated during this period did not interfere with normal periodontal and pulp healing of the transplants<sup>16,18,19</sup>. Nonetheless, in transplants with complete root development, orthodontic movement might result in a slight increase in the frequency of surface and inflammatory resorption<sup>5</sup>.

Experimental studies have shown that pulp necrosis, poor periodontal healing, and root resorption occurred more frequently in transplanted teeth with mature root development when compared to those with immature roots<sup>5-9,12</sup>. It is therefore recommended that endodontic treatment should be carried out within 1 month of the surgical procedure for fully developed teeth<sup>6</sup>. Andreasen *et al*<sup>5</sup> demonstrated that transplanted premolars with complete root formation treated endodontically at 4 weeks had 98% survival rate. We report a case where autotransplantation of premolars with fully formed roots was integrated with orthodontic treatment.

## Case report

### History and clinical examination

The patient was a 13-year-old Chinese boy who complained of missing teeth and gaps (Figure 1). A removable lower partial denture had been made to replace the missing teeth but the patient disliked it and did not wear it much. A medical history revealed that the patient had glucose-6-phosphatase deficiency.

On frontal examination, the patient had a symmetrical face with reduced lower facial height. His lips were full and incompetent at rest. The lower lip was everted and short. His profile was convex with an acute nasolabial angle. There were no signs or symptoms of temporomandibular joint dysfunction.

Intraorally, the patient had 24 permanent teeth and was missing teeth 31, 41, 44, and 45. Tooth 85 was retained and the alveolar bone corresponding to the area of 44 was restricted. The upper lateral incisors were peg-shaped. The oral hygiene was good and the periodontal condition stable. The overjet was increased at 6 mm and the upper incisors were proclined. There was an arch length surplus of 7 mm in the maxillary arch and 28 mm in the mandibular arch.

A panoramic radiograph confirmed the presence of 25 permanent teeth, with teeth 28, 38, 31, 41, 44, 45, and 48 missing. Cephalometric analysis revealed a mild class

II skeletal base relationship attributed to a prognathic maxilla. The upper anterior facial height was increased and the mandibular plane was relatively flat. Both the upper and lower incisors were proclined leading to a decreased interincisal angle.

### Diagnostic summary

The patient had class II division 1 malocclusion with bimaxillary proclination of incisors. He had missing lower central incisors and lower right premolars.

### Treatment plan

The treatment objectives were as follows: to normalize the overjet; to align teeth and coordinate the arches and to achieve good occlusal interdigitation; and to improve the masticatory function and dental appearance.

The treatment plan integrated orthodontics and autotransplantation, with the extraction of the retained tooth 85 and the transplantation of the upper first premolars (teeth 14 and 24) in place of the missing lower right premolars. The upper first premolars were chosen as the donor teeth as extraction of these teeth facilitated the reduction of the overjet. The orthodontic treatment plan aimed at space redistribution for the transplantation, space closure of the missing lower incisors, and overjet reduction. As two lower incisors were missing, the aim was to finish with the upper canines in a class I relationship with the lower first premolars. The resultant Bolton excess in the lower anterior region would be compensated for by composite build-up of the upper anterior teeth. The removal of the upper premolars for overjet reduction provided donor teeth for transplantation, thus avoiding extensive restorative work on the right side of the mandible. With this option, the patient did not need to wait until the completion of growth if osteointegrated implants were to be placed. Other treatment options included the extraction of the peg-shaped lateral incisors, space closure, and prosthodontic replacements of the missing teeth 44 and 45.

### Treatment progress

Thorough oral hygiene instruction and dietary advice were given before treatment was commenced. Initially only lower pre-adjusted edgewise fixed appliances ( $0.022 \times 0.028$ -inch slot) were fitted. After leveling and alignment, space was redistributed for transplants in the 44, 45 region and teeth 33 to 43 were approximated. Autotransplantation

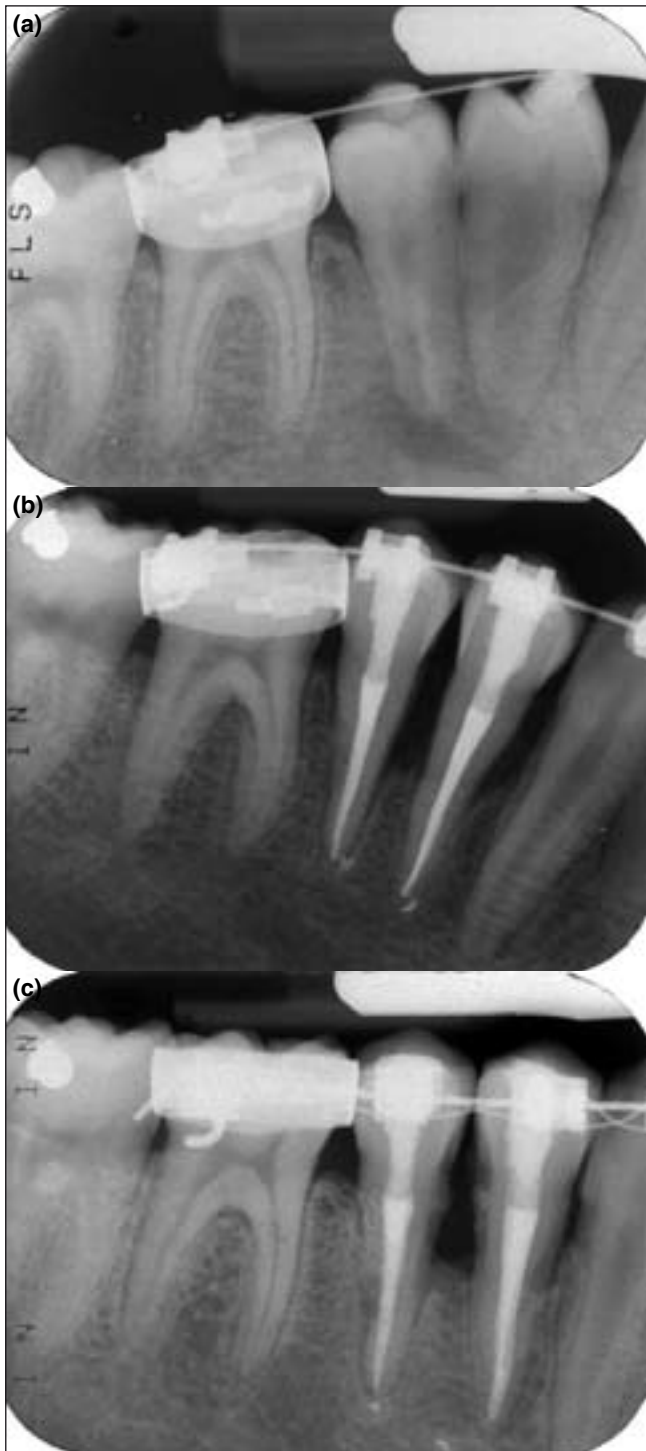
was performed under general anesthesia. Teeth 14 and 24 were extracted with a careful atraumatic technique to avoid damage to the periodontal ligament. A mucoperiosteal flap was raised at the recipient site of the lower right quadrant. Tooth 85 was extracted and two sockets were prepared in the alveolus corresponding to the 44 and 45 region. The donor teeth were then placed in the recipient sockets, slightly below the occlusal level. Because of reduced bone width in the 44 alveolar region, the transplant was placed in a rotated position. The transplanted teeth were then fixed with composite resin to the archwire. The sutures were removed 2 weeks after surgery.

The patient did not attend the 4-week follow-up appointment to initiate endodontic treatment of the transplants. He returned 2 months after the autotransplantation procedure, at which time both clinical and radiographic examinations revealed the presence of external inflammatory root resorption (Figure 2a). There was also alveolar bone loss at the interproximal region of the transplants down to the mid-root level. A 4-mm pocket was present distal to transplant 44 and medial to transplant 45, with bleeding and inflammation of the gingiva. Endodontic treatment was performed immediately, with the transplant pulps extirpated and dressed with calcium hydroxide. The patient was also referred to the periodontist for thorough scaling and root planning. He was recalled every 3 months for supportive periodontal therapy and monitoring of his periodontal status. The transplants were obturated with gutta-percha and AH plus® (Dentsply International, USA) by warm vertical compaction (Figure 2b) after 6 months.

Fixed appliances were fitted in the upper arch after the surgery and the peg-shaped 12 and 22 were built up with composite resin. Orthodontic alignment of the transplants was carried out after 4 months and a very gentle force was used to de-rotate the transplanted 44. After alignment, a series of reverse curve archwires were used to level the lower arch. Space closure was carried out with sliding mechanics using NiTi closing coil springs along  $0.019 \times 0.025$ -inch stainless steel archwires, supported with class II elastics and cervical-pull headgear. After space closure was complete, finishing and detailing was carried out using  $0.017 \times 0.025$ -inch titanium molybdenum alloy archwires. Teeth 11 and 21 were also built up in width to compensate for the Bolton excess in the lower anterior region. The final records are shown in Figure 3.

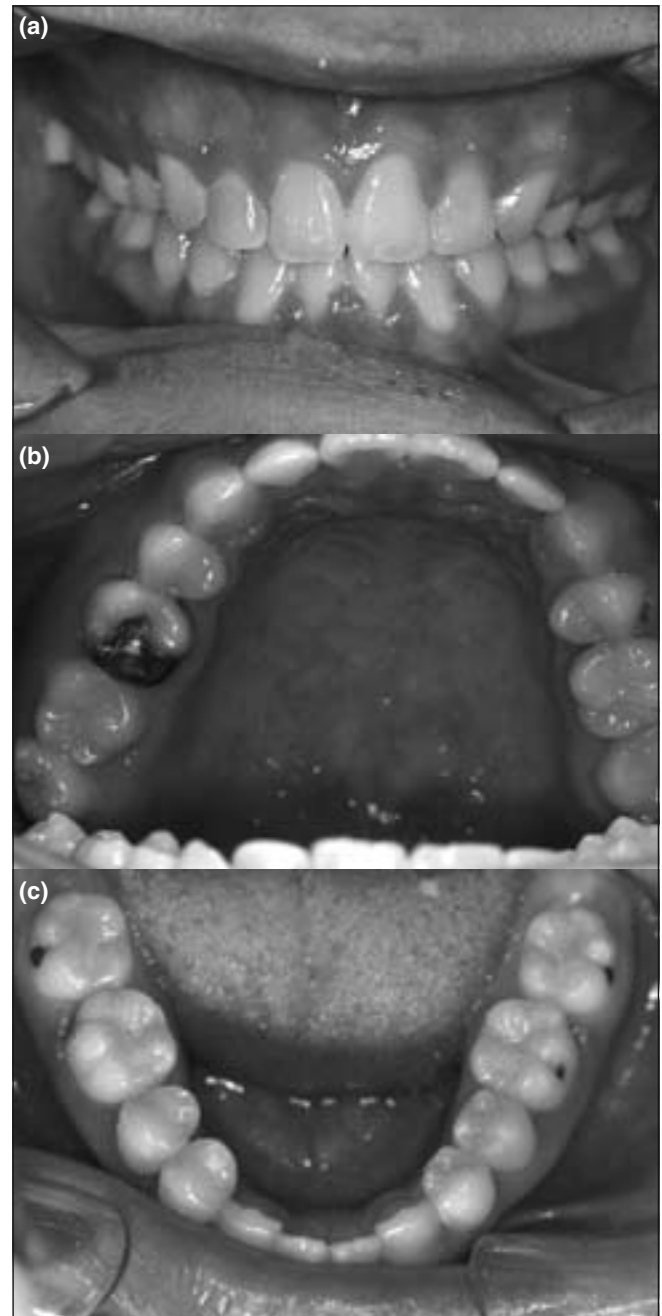
### Results achieved

All treatment objectives were achieved. The class II



**Figure 2** Periapical radiographs of the transplants (a) 2 months after surgery; (b) after obturation; and (c) at the end of orthodontic treatment

division 1 malocclusion was corrected and a functional occlusion was established with the replacement of the missing premolars. There was improvement of the facial profile as facial convexity and fullness of the



**Figure 3** Posttreatment photographs

lips were reduced following retraction of the upper incisors. The lips became competent at rest. The transplanted teeth maintained normal mobility without further progression of root resorption and a normal lamina dura could be seen radiographically. Although the periodontal pocket at the interproximal regions of the transplants remained, the periodontal tissues were healthy and showed no inflammation. Radiographically,



the interproximal bone level between the transplants was increased to up to two thirds of the roots by the end of treatment (Figure 2c).

## Discussion

Osteointegrated implants are now the preferred treatment alternative for replacing missing teeth. Experience to date has shown that single-tooth implants have a favorable prognosis, with survival rates of 90% at 10 years in multicenter studies<sup>20,21</sup>. Nonetheless, the use of implants is contra-indicated in growing patients. Since implants are ankylosed to the alveolar bone, any residual facial growth will result in infra-occlusion of the implants. Also, a single tooth implant may have a less-than-desirable esthetic result because of the difficulty of obtaining a natural gingival contour<sup>22</sup>.

Autotransplantation represents a biologic approach in which transplanted tooth germ retains the potential to induce alveolar bone formation. An implant is an artificial replacement and requires bone-regeneration when the alveolar bone support is insufficient. Because a layer of normal periodontal ligament is retained, an autotransplanted premolar can be moved orthodontically like any other tooth. An osteointegrated implant is ankylosed to the bone and its position cannot be changed. During continued facial growth, a transplanted tooth will erupt in synchrony with the neighboring teeth and adapt to functional stimuli. An implant will not follow the neighboring teeth vertically during tooth eruption.

Previous studies have shown that pulpal survival is not to be expected on transplants with fully developed roots<sup>5,14</sup>. Therefore, it is appropriate to start endodontic therapy as soon as the periodontal tissues have healed after the transplant procedure. The delay in carrying out endodontic treatment for this patient might be the reason for the root resorption of his transplants. The resorptive process stabilized when the endodontic treatment was completed. Despite the early loss of interdental bone between the transplanted teeth in this case, posttreatment radiographs showed some degree of positive bone remodeling (compare Figures 2b and 2c). It appears that autotransplantation may provide functional stimulation of the alveolar bone, preventing its resorption after the loss of deciduous teeth. By preserving the alveolar bone, autotransplantation can also be regarded as an interim measure for facilitating future placement of an osteointegrated implant once growth has ceased or if failure of the transplant occurs.

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